Draft:

Michigan's Terrestrial Invasive Species State Management Plan

Coordinated by the Terrestrial Invasive Species Core Team

2016-2021 | Public Review
May 16 – June 24, 2016

A Cooperative Effort of the
Michigan Department of Agriculture and Rural Development
Michigan Department of Environmental Quality
Michigan Department of Natural Resources
Michigan Department of Transportation
In Consultation and Partnership with Other Interested Parties

Feral Pig Photo Credit- Chris Grady

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INTRODUCTION

Terrestrial invasive species (TIS) are damaging Michigan's forest, dune, grassland, agricultural and urban environments. Terrestrial invasive species include non-native plants, insects, animals, and pathogens that harm Michigan's environment, economy or human health. Emerald ash borer, feral hogs, Japanese knotweed, oak wilt, and the fungus that causes white nose syndrome in bats are a few examples of TIS that are currently affecting Michigan. Invasive species cause billions of dollars in damage annually, are extremely costly to control, and often have irreversible ecological effects. Throughout the state of Michigan, invasive species programs exist at various organizational levels; however, these efforts are fragmented and insufficient to control the growing problem of TIS. A coordinated, statewide, strategic effort will more effectively limit the economic and environmental impacts of terrestrial invasive species.

What are Terrestrial Invasive Species?

Terrestrial invasive species may also be referred to as nonindigenous, nuisance, exotic or non-native species; however, each of these terms has a slightly different meaning, and care should be taken to use each term appropriately. Most non-native species are not invasive and support human livelihoods or a preferred quality of life. Some non-native species provide valuable benefits including the majority of agricultural and horticultural species. Any terrestrial invasive species covered under the scope of this plan is defined as:

> ***"A terrestrial species that is non-native to the ecosystem under consideration AND whose introduction causes or is likely to cause economic or environmental harm or harm to human health*."***

**Direct human health issues resulting from invasive species are rare but of great concern. The spread of human-related illnesses is considered by epidemiologists and studied separately from invasive pathogens that harm non-human hosts; therefore, invasive species that only present threats as human pathogens are not considered within the scope of this plan. The invasive species program works closely with human health agencies and professionals to address crossover of invasive species and diseases impacting both humans and animals.*

Michigan's Terrestrial Invasive Species Core Team

This team is part of a comprehensive Michigan Invasive Species Program (Appendix A) and is made up of representatives from the Departments of Agriculture and Rural Development, Environmental Quality, Natural Resources and Transportation. The team is responsible for ensuring a cohesive TIS program, developing and implementing the TIS State Management Plan, and making recommendations on priorities and budget, including grant opportunities.

Cause for Concern

Michigan provides diverse recreational opportunities, supports a growing natural-resource based economy and offers a unique quality of life for its citizens and visitors. The state's diverse habitats support a complex network of native species. With over 3,200 miles of shoreline, 20 million acres of forest and 5.5 million acres of wetlands, Michigan's landscape provides invaluable economic, cultural, ecological and recreational resources that are threatened by the growing problem of invasive species. The following examples illustrate these impacts:

- Each year, Michigan's Forest Industries support 87,000 jobs and provide an annual $17.8 billion boost to the state's economy (Leefers 2015). Invasive forest pests including emerald ash borer, oak wilt and beech bark disease kill native trees and significantly impact the value of urban properties, forests and timber resources. The estimated cost of emerald ash borer treatment per year in Michigan is $15.9 million (Kovacs et al. 2010).
- Michigan's farm commodities contribute $13 billion annually to the state's economy (Knudson and Peterson 2012), and Michigan boasts the second highest crop diversity in the United States (Michigan Department of Agriculture and Rural Development 2012). The U. S. Department of Agriculture has identified 19 invasive agricultural pests of concern threatening crop production in Michigan (Pest Tracker, 2015).
- According to the U.S. Fish and Wildlife Service, hunters and wildlife watchers in Michigan spent over $3.5 billion in 2011 (U.S. Department of the Interior et al. 2011).
- Invasive wildlife diseases like chronic wasting disease (CWD) and white-nose syndrome (WNS) not only limit recreation opportunities, but have extensive economic impacts. Wisconsin estimated an economic loss of up to $83 million in 2003 due to CWD (Bishop 2003)and bat declines due to WNS lead to economic losses of an estimated $3.7 billion per year nationally (Boyles et al. 2011).
- Michigan's 36 million acres of land provide habitat for over 500 species of terrestrial wildlife, of which 73 are listed as species of greatest conservation need; TIS are recognized as a significant threat to recovery for over half of these species (Derosier et al. 2015).
- Visitor spending brings over $17 billion dollars to Michigan annually and supports over 150,000 jobs (Tourism Economics, 2014). Invasive species impact the use and beauty of Michigan's shorelines, trails and parks, which may result in a reduction in visitor spending and citizen enjoyment.

Economic Effects of Terrestrial Invasive Species

- *Decreased aesthetic and recreational value of terrestrial resources including reduced or impaired trail use and hunting opportunities (Charles and Dukes 2007).*
- *Decreased tourism and opportunity for wildlife viewing (Charles and Dukes 2007).*
- *Decreased value or loss of timber products (Charles and Dukes 2007).*
- *Damage to infrastructure and equipment (Pejchar and Mooney 2009).*
- *Decreased aesthetic quality and value of real estate including residential homes.*
- *Impacts to urban forests including loss of thermal cooling, increased rainwater runoff and loss of other green infrastructure (Charles and Dukes 2007).*
- *Decreased yields and increased use of pesticides in agricultural crops (Pejchar and Mooney 2009).*

Environmental Effects of Terrestrial Invasive Species: Shoreline Erosion

The shorelines of the Great Lakes are a dynamic and ever changing environment. Natural forces shape the beaches, dunes and bluffs, contributing to the natural process of erosion and the native species that evolved under these conditions. Invasive species such as lyme grass, Japanese knotweed and baby's breath threaten biodiversity. They compete with native species for space, water and nutrients, limiting the habitat and survival of native species. Although invasive plants may stabilize a site the risks often outweigh the benefits of interrupting natural shoreline processes.

A Statewide Strategy

The TIS State Management Plan (SMP) outlines a statewide strategy to reduce the economic and environmental damage caused by terrestrial invasive species. The plan's four goals are: prevention; early detection and response; control and restoration; and collaboration. The plan's six activity areas address elements of all four of these goals.

Each activity area contains objectives and strategic actions that implement one or more of the plan's four goals. These activities will assess risk, provide guidance for management, support targeted monitoring and research, elevate outreach programs, address regulation and policy concerns, and strengthen leadership and coordination.

TERRESTRIAL INVASIVE SPECIES STATE MANAGEMENT PLAN

GOALS AND ACTIVITY AREAS

GOALS

1. Prevention

Prevent the introduction of new terrestrial invasive species to Michigan.

Preventing the introduction of terrestrial invasive species into Michigan is the most effective management option (Leung et al. 2002). Prevention intervenes before resources are damaged - before there is a need for detection or costly treatments to eradicate or control the invasive organism. The most efficient method for prevention combines identifying the species that pose imminent threats (risk assessment) and determining the pathways through which they are introduced, then working to interrupt these pathways (Leung et al. 2002). By periodically examining and addressing pathways, we will reduce the risk of new TIS introductions.

Risk assessment is the process of identifying high priority invasive species that are likely to be introduced through various pathways. It requires science-based information and active communication with regional, national and international partner agencies to identify invasive organisms that can potentially harm Michigan's resources. Once identified, an analysis of the organism's potential effects on agriculture, natural resources and the economy, as well as its potential for establishment and spreading, determines the level of risk it presents. Risk assessment will provide the information needed to update the list of prohibited or restricted species in Michigan as required by Part 413, Transgenic and Nonnative Organisms, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA).

Pathways of introduction: The most effective means for preventing new TIS in Michigan is through interruption of pathways for new introductions (Leung et al. 2002). Understanding the various methods that physically transport TIS and the modes or pathways of introduction provides a starting point for prevention measures.

Many invasive plants have been intentionally introduced as ornamentals or for some derived benefit such as erosion control or as a resource for wildlife (Michigan DNR and MNFI 2012a, 2012b). Likewise, some invasive species have been purposely imported as pets, food or as controls for other nuisance species. TIS are often introduced unintentionally through human-assisted means such as moving firewood, "hitchhikers" attached to clothing or boot soles, hauling soil or fill materials from infested areas or using pest-ridden wooden packaging for shipping (Michigan DNR 2008).

One important means of interrupting the pathways for invasive species transportation is to keep state and local agencies, and the public informed of the likely pathways these invaders will follow. Informing them of the importance of cleaning of vehicles and gear, buying local firewood, choosing the right plant, and not releasing pets are all ways which can help reduce the risk of introducing or spreading TIS.

Prevention Spotlight: Asian Longhorned Beetle (*Anoplophora glabripennis*)

Preventing the Asian longhorned beetle (ALB) from entering Michigan requires the help of all citizens and visitors. ALB can hitchhike into and around the state on infested wood. "Don't Move Firewood!" is a measure of prevention to keep our forests safe. Maple trees are the ALB's favorite host (Hu et al. 2009). More than 1 billion maple trees grow in Michigan (Leatherberry and Spencer 1996). ALB can attack and destroy many other tree species, including birch, buckeye, elm, horse chestnut and willow. Larvae feed in tunnels in the wood of tree branches and trunks. These galleries cause branches to break and will eventually kill the tree. ALB populations are known to be present in areas of southern Ohio, Massachusetts and New York and Ontario (MISIN, 2015).

Table 1: Common Pathways and Subpathways of Introduction

Pathways	Subpathways
Firewood or wood	Recreational use Commercial use
Habitat Modification and Restoration	Mowing Land clearing/development Logging Revegetation
Hitchhikers	Travelers Baggage and gear Shipped materials Pets and animals
Organisms in Trade	Whole plants, plant parts Pet trade Food and game animals
Recreation	Trailusers Hunters and anglers Wildlife viewers
Research and Monitoring	Equipment and sampling gear
Wood Products	Solid wood packing materials Mulch Commercial wood products
Transportation	Cars, trucks, buses Construction and maintenance equipment Helicopters, planes, trains

Climate Change and Invasive Species – An Emerging Threat

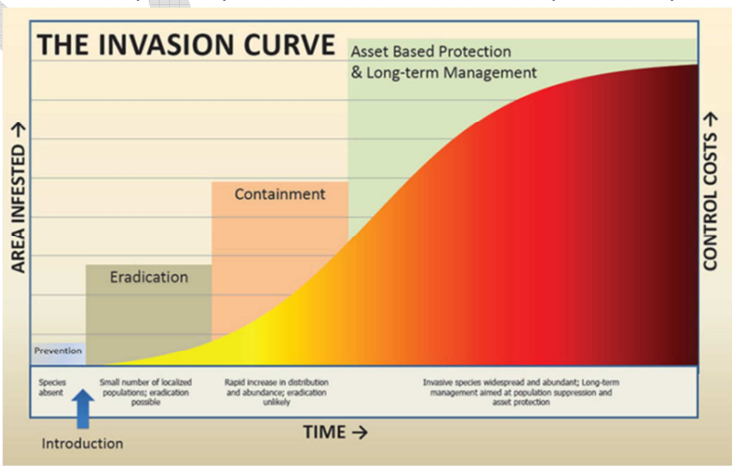
Michigan's climate is warmer, with more precipitation falling in extreme storms. Continued change will increase the potential for new invaders in Michigan (Hoving et al. 2013). From mammals to birds, snakes to butterflies, widespread range shifts in Michigan have already been documented. With continued climate disruption, we will see more and greater impacts. Mobile species are shifting. Less mobile species are declining or stressed, creating opportunities for extremely mobile invasive species, including forest pests and diseases. Protecting Michigan's native landscapes requires incorporating strategic actions that support monitoring, research, and response to new threats as they arise in the wake of a changing climate.

2. Early Detection and Response

Detect terrestrial invasive species as they arrive and respond to prevent their establishment and spread in Michigan.

While prevention of new TIS is the first goal of this plan, some invasions, such as emerald ash borer, have already occurred and new ones are inevitable. Early detection of new occurrences and directed response efforts will reduce the likelihood of establishment and reduce the cost of long-term management. Early detection requires a system of continuous monitoring and reporting throughout the state. Such a system will be built through collaboration with, and training of, state and local agencies, volunteer groups and committed citizens. Once the presence of a new invasive has been verified by an expert, options to control and ideally eradicate this species are evaluated. If a response is warranted, work begins on coordinating across multiple organizational levels, reviewing and securing resources, and assigning trained staff and contractors to implement the response. A statewide approach provides the best opportunity for control and eradication. Protecting valued native terrestrial resources from invasive species requires dedicated resources for monitoring, response and suppression activities.

**Sample Graphic For Demonstration Purposes Only



Preparation is the key to a successful early detection and response program. A TIS Response Plan will be created to outline a process of communication, action and evaluation. Broad collaboration with state, federal and international partners will be sought to develop additional response plans specific to Watch List species (Appendix B). Together these plans will identify habitat, hosts, and vulnerable ecosystems to focus survey efforts. Understanding the impacts of an invasive organism to the health and productivity of vulnerable resources with and without control provides a strategic assessment for allocating resources. Assessing response measures and standardizing methods for monitoring, treatment, and evaluation will best prepare the State and its partners to address new invasive species.

Invasive Species Watch List: *Michigan's Invasive Species Watch List (Appendix B) provides an up-to-date listing of organisms identified by the state's Invasive Species Core Teams as being immediate and significant threats to Michigan's economy, agriculture, and/or natural resources. These species either have never been confirmed in the wild in Michigan or are known to be in limited areas only. Early detection and timely reporting can keep these species from spreading throughout Michigan.*

3. Control and Restoration

Control terrestrial invasive species to minimize the harmful environmental, economic and public health effects resulting from established populations. Restore habitats as appropriate.

Once an invasive species becomes established or widespread, its eradication potential is severely diminished, and effective control requires a long-term investment of resources (Lodge et al. 2006). Deciding when and where to invest these resources is part of a necessary process of prioritization. This process considers several factors including value and vulnerability of the ecosystem, irreversibility of the threat, potential for success, and public interest. In addition, prioritization requires consideration of existing and future threats and the resources available for management action. Allocating resources needs to take into consideration the impacts of TIS relative to the cost of control efforts. Once the viability of treating an established species is identified, the progress of treatment generally follows the method of prioritization by density of infestation.

Developing species-specific comprehensive management strategies, best control practices and restoration techniques to mitigate negative impacts are critical needs in managing established TIS statewide. Providing these tools will allow resource managers and partners to effectively approach established TIS with an increased likelihood for successful mitigation and potential eradication.

Control Practices – Oak Wilt

Oak wilt is an invasive fungus threatening Michigan's red oak trees. Infected trees die quickly, often within a few weeks of the appearance of symptoms (O'Brien et al. 2011). Beetles that have visited infected oaks carry the spores of the fungus long distances to healthy oaks. The disease, which occurs across much of the state in both urban and forest settings, moves rapidly to neighboring healthy oak trees through root systems that have grafted with diseased trees (O'Brien et al. 2011). While oak wilt-infected trees cannot be saved, healthy trees can be protected by breaking root grafts before the disease can spread. A 5-foot-long steel blade mounted on a vibratory plow is used to sever the root systems below ground. Red oak trees growing inside the treatment lines are then cut and chipped, burned or sawed into lumber to help prevent overland spread of the disease.

Treatment of oak wilt areas will:

- *Protect timber value in forests with high-value oak.*
- *Control small, isolated areas of oak wilt to minimize the risk of spreading.*
- *Preserve recreational value in and around state and federal recreation areas.*
- *Protect residential property values.*
-

The public is reminded not to move firewood, which may contain oak wilt spores, and not to prune oak trees between April 15 and July 15 to prohibit spores from colonizing tree wounds.

4. Collaboration

Encourage collaboration to optimize solutions and share resources, knowledge and skills.

Combatting terrestrial invasive species requires the knowledge and expertise of individuals from many disciplines and in many organizations including universities, government agencies, NGOs and the private sector. A commitment to seeking the input of experts, cooperating in shared pursuits, and directing research to needed areas will assure the most successful and fiscally responsible actions. Significant work is needed in the areas of risk assessment, pathway reduction across boundaries and borders, rapid response methods for watch list species and control and management options.

Just as resource experts are needed to conceptualize and test strategies, partners are needed to assist in carrying out the TIS SMP, from prevention, to detection, to management and restoration. Local resources such as conservation districts and Cooperative Invasive Species Management Areas provide citizens with information on invasive species and treatment options, and manage on-the-ground control activities. Citizens and private sector partners in areas such as agriculture, forest products, construction and transportation can contribute in important ways to prevention and detection efforts.

Cooperative Invasive Species Management Areas (CISMAs)
CISMAs are regional collaborative organizations that address invasive species across their geographic area. Local, state, federal and tribal governments, private and non-profit partners join together in various geographic areas to form CISMAs for their communities. CISMAs provide outreach and information, encourage resource sharing and facilitate strategic management of priority invasive species. CISMAs facilitate cooperation and coordination across jurisdictional boundaries. A map of current Cooperative Invasive Species Management Areas in Michigan can be found in Appendix C.

ACTIVITY AREAS

To meet the four goals of the TIS SMP, activities have been categorized into six areas: Risk Analysis, Management Practices, Monitoring and Research, Outreach and Education, Regulation and Policy, and Leadership and Coordination. Aspects of each of these activity areas support the plan's four goals. Objectives and strategic actions are defined for each activity area. Details for these objectives and actions, including example tasks and measures of success are expressed in the Implementation Table in Appendix D.

The Implementation Table provides example tasks, measures of success, lead state agency, and cooperating agency or organizations. The Implementation Table will be used as a guide for implementing the SMP, tracking progress, assigning roles, and contributing to program evaluation. Partners can consult the Implementation Table to find how their organization's efforts assist the overall plan.

I. Risk Analysis

Develop and implement a methodology to assess the risk of new invasives based on their aggressiveness, adaptability, and potential costs to the environment, economy and human health.

Tools to prioritize levels of risk for existing and emerging TIS will aid managers in making efficient and effective response decisions. Risk assessment involves understanding which ecosystems are most susceptible to TIS based on the value of their natural processes and relative rarity of the species they support. Likewise, the level of threat posed by an invasive based on its aggressiveness, sustainability in Michigan's climate, and level of potential damage to Michigan's resources also factors in to risk analysis.

OB = Objective SA = Strategic Action

OB I.A. Identify and prioritize ecosystems vulnerable to TIS.
SA I.A.1. Implement a science-based risk-assessment process to analyze the level of ecosystem susceptibility and vulnerability to TIS.
SA I.A.2. Define high-value ecosystems to facilitate prioritization of detection, response and management efforts.
OB I.B. Identify and prioritize current and potential high-threat TIS.
SA I.B.1. Implement a science-based risk-assessment process to analyze the level of risk of potential TIS and the likelihood of introduction.
SA I.B.2. Develop a prioritization process for prevention, detection and control of TIS.
OB I.C. Analyze the impacts of landscape level factors.
SA I.C.1. Identify potential and high threat TIS, impacts and pathway changes under various climate change scenarios.
SA I.C.2. Identify contributing factors that inhibit management of TIS: e.g., non-point source pollution, urbanization, fragmentation, ownership patterns, etc.
OB I.D. Analyze pathways of TIS introduction and spread.
SA I.D.1. Further refine and prioritize current list of TIS pathways and associated subpathways.
SA I.D.2. Review TIS pathways and identify emerging TIS pathways.

II. Management Practices

Develop and disseminate protocols and strategies for effective TIS management and ecosystem restoration.

Successful management of TIS requires a suite of tools to implement management actions. Those managing terrestrial invasive species need well-formulated methods for determining how to prioritize efforts and allocate resources, knowledge of appropriate and effective techniques for TIS control, and streamlined processes for obtaining permits and certifications necessary to complete control. Through these strategic actions, managers will be better equipped to tackle the challenges of TIS management at all organizational levels.

OB = Objective SA = Strategic Action

OB II.A. Minimize impacts of TIS through control activities.
SA II.A.1. Prioritize and strategically implement control at state, regional, and local scales.
SA II.A.2. Ensure control activities have expected outcomes and measures of success.
SA II.A.3. Evaluate treatments and actions.
OB II.B. Decrease likelihood of new TIS establishing and spreading in Michigan.
SA II.B.1. Build partnerships and recruit partners in response efforts.
SA II.B.2. Respond to reports of new TIS through implementation of actions outlined in the TIS Response Plan.
SA II.B.3. Control or eliminate pathways of introduction or spread.
OB II.C. Incorporate TIS prevention, detection and control into land management plans and activities.
SA II.C.1. Assess goals of management activities and identify TIS that may impact management.
SA II.C.2. Ensure permits address known TIS threats and best management practices for prevention and control.
SA II.C.3. Identify and mitigate land management activities that facilitate introduction and spread of TIS through known pathways.
SA II.C.4. Increase number of management activities that contribute to a reduction in TIS.
OB II.D. Prevent future TIS invasions and restore ecosystem integrity through enhanced restoration and rehabilitation strategies.
SA II.D.1. Support programs conducting restoration and rehabilitation work.
SA II.D.2. Develop and implement prioritization techniques for restoration and rehabilitation projects.
SA II.D.3. Assess effectiveness of restoration and rehabilitation efforts.
SA II.D.4. Develop new and improve existing restoration and rehabilitation techniques based on local management objectives and feasibility.

III. Monitoring and Research

Coordinate monitoring efforts and direct research efforts to improve the effectiveness of TIS management strategies.

Knowledge about invasive species and treatment practices is incomplete and evolving. Standardized data collection and carefully directed research efforts are needed to identify priorities for action that will prevent or minimize the spread of invasive species. With a thorough understanding of current and emerging invasive species threats, managers will be better equipped to prevent new introductions, detect new invasions and respond to infestations. Well-developed monitoring programs provide invaluable information that can be used to prioritize efforts and allocate limited resources effectively. Supporting scientific inquiry will ensure that managers are on the forefront of emerging technologies and approaches to invasive species threats. Acquiring and maintaining important data on the threat,

status and distribution of TIS will help drive science-based decision-making and improve the effectiveness of invasive species management.

OB = Objective SA = Strategic Action

OB III.A. Improve surveillance, reporting and data management with a focus on pathways, risk analysis and early detection.
SA III.A.1. Expand and improve existing information gathering and data sharing networks.
SA III.A.2. Develop, distribute and implement standardized monitoring and reporting protocols for use by multiple agencies and partners.
SA III.A.3. Monitor vulnerable ecosystems in rural and urban terrestrial environments.
SA III.A.4. Enhance and implement detection efforts at strategic points of entry and high risk pathways.
SA III.A.5. Build knowledge base of the distribution and abundance of existing key terrestrial invasive species.
OB III.B. Expand research on TIS.
SA III.B.1. Quantify economic, ecologic, social and landscape level impacts of TIS.
SA III.B.2. Support research priorities with a focus on prevention, detection, control and restoration.
SA III.B.3. Identify and develop technology and bio-control for key invasive species.
OB III.C. Track implementation and assess effectiveness of TIS plan.
SA III.C.1. Develop a system for tracking activities and accomplishments by agencies and partners.
SA III.C.2. Evaluate actions implemented under this plan.
SA III.C.3. Monitor accomplishments and provide annual update to decision-makers and stakeholders.

The Midwest Invasive Species Information Network (MISIN)

Led by Michigan State University, MISIN is a regional effort to develop and provide an early detection and monitoring resource for invasive species. The goal of this resource is to assist both experts and citizen scientists in the detection and identification of invasive species in support of their successful management. MISIN provides information on invasive species identification, allows participants to report species sightings online and through a smartphone app and provides species distribution maps based on these reports. www.misin.msu.edu

IV. Outreach and Education

Provide TIS program managers and citizens with information and training to increase local involvement in prevention, detection and control efforts.

Engaging diverse audiences through outreach and education efforts will enhance capacity for on the ground management of TIS. Developing and sharing of information that clearly and concisely describes

the impacts of TIS will raise awareness of the issue across a broad base of Michigan residents and among TIS managers. Widespread training and promotion of best management practices and procedures to decontaminate gear and vehicles will aid in reducing the spread of invasive species. Through targeted outreach and education efforts, agencies, partners, and the public can identify opportunities for increased participation in prevention, detection, management and control programs.

OB = Objective SA = Strategic Action

OB IV.A. Increase public awareness of TIS impacts and threats using public and private partnerships.
SA IV.A.1. Develop outreach campaigns tailored to specific audiences, integrating the use of social media, videos, printed and web-based materials.
SA IV.A.2. Provide education and outreach through symposia and workshops for landowners, local government officials, resource management professionals and retail trade.
SA IV.A.3. Incorporate TIS into educational programming for youth and adults.
SA IV.A.4. Assess changes in attitudes and behavior through surveys of target audiences.
OB IV.B. Prevent the introduction and limit the spread of TIS through public outreach, staff training and information sharing.
SA IV.B.1. Enhance existing and develop additional training resources on identification of TIS.
SA IV.B.2. Improve and simplify access to resources for training and reporting.
SA IV.B.3. Engage partners and the public in identification of high threat TIS and reporting to a centralized database.
SA IV.B.4. Develop pathway-oriented outreach materials to distribute to target audiences at strategic locations.
SA IV.B.5. Provide education on decontamination and Best Management Practices (BMPs) to limit the spread of TIS.
SA IV.B.6. Provide education on TIS regulations, policies, laws and quarantines.
OB IV.C. Improve the effectiveness of TIS control through education and training on control measures.
SA IV.C.1. Provide training opportunities on BMPs, control methodology and treatment monitoring.
SA IV.C.2. Develop outreach materials informing public about TIS, management, control, and outcomes.
SA IV.C.3. Promote protective measures and BMPs through communication and coordination with partners.

V. Regulation and Policy

Use current research and data to develop and revise state policies and regulations for management of TIS.

Prevention, early detection and response to new TIS are most successful when bolstered by enforceable regulations. Developing policies and response actions that are based on risk assessment will promote

success in preventing new invasions. Identifying and addressing barriers to effective monitoring, research, detection and response will improve the outcome of management efforts by enhancing regulatory authority and enforceability of existing legislation. Providing clear and concise information on laws and policies and streamlining processes will promote compliance among industries, recreational users and partners.

OB = Objective SA = Strategic Action

OB V.A. Improve regulatory and policy frameworks for invasive species management.
SA V.A.1. Use risk assessments to conduct annual review and update the Prohibited and Restricted Species list (NREPA Part 413).
SA V.A.2. Identify and address gaps and inconsistencies in state policies, procedures, permits, land use orders, quarantines and legislation.
SA V.A.3. Enhance capacity to enforce TIS legislation and policies.
OB V.B. Secure resources for high-priority invasive species projects.
SA V.B.1. Identify resource needs and funding gaps for implementation of invasive species projects.
SA V.B.2. Leverage existing resources and develop incentives to maximize management capacity.
SA V.B.3. Create stable funding sources for TIS.

The Law in Michigan: *In 2003 the state legislature passed a law regulating the introduction and further spread of invasive species in Michigan. Part 413, Transgenic and Nonnative Organisms, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA) was written as a preventative measure to stop invasive species with the potential to harm human health or to harm natural, agricultural, or silvicultural resources. Included in the legislation is a list of prohibited or restricted species. Annually, species may be added, deleted or re-classified by the legislature based on recommendations from the Natural Resources Commission or the Commission of Agriculture and Rural Development in consultation with the departments of Natural Resources and Agriculture and Rural Development. This list acts as a first line of prevention and awareness, with other supporting activities strengthening this effort. A current list of Part 413 terrestrial species is included in Appendix E.*

VI. Leadership and Coordination

Provide leadership and coordination for statewide efforts to prevent, detect, manage and control terrestrial invasive species.

TIS prevention, detection and management occur at multiple levels of government, among numerous partners and within variable frameworks across the state. To enhance the ability to prevent introductions, limit dispersal and improve effectiveness of long-term management measures, it is essential to put forth a cohesive and comprehensive interagency effort, provide support for external partners and facilitate informed decision-making. These strategic actions aim to enhance coordination among state agencies and to build leadership capacity to advance TIS management at all levels across the state.

OB = Objective SA = Strategic Action

OB I.A. Improve capacity to detect and respond to high-threat and emerging TIS.
SA VI.A.1. Develop an interagency TIS Response Plan.
SA VI.A.2. Develop and support a first detector network of trained personnel at strategic locations.
SA VI.A.3. Develop and implement species-specific response plans.
SA VI.A.4. Test and evaluate response plans through mock detections or exercises.
OB I.B. Increase technical expertise available for TIS information and identification.
SA VI.B.1. Establish a network of local, state and regional experts to inform TIS planning and action.
SA V I.B.2. Create and maintain list of taxa specific TIS verification experts.
OB I.C. Prevent and manage TIS through coordination and collaboration with partners at multiple levels.
SA VI.C.1. Find common approaches to harmonize cross-jurisdictional action with federal and state agencies and local municipalities.
SA VI.C.2. Develop and support vital partnerships to increase understanding of impacts, available resources and needed capacity.
SA VI.C.3. Work collaboratively with industry to address pathways of introduction through prevention, detection and control.
SA VI.C.4. Foster partnerships that increase the likelihood of management and research success and eliminate duplicative efforts and expenditures.

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Glossary of Terms

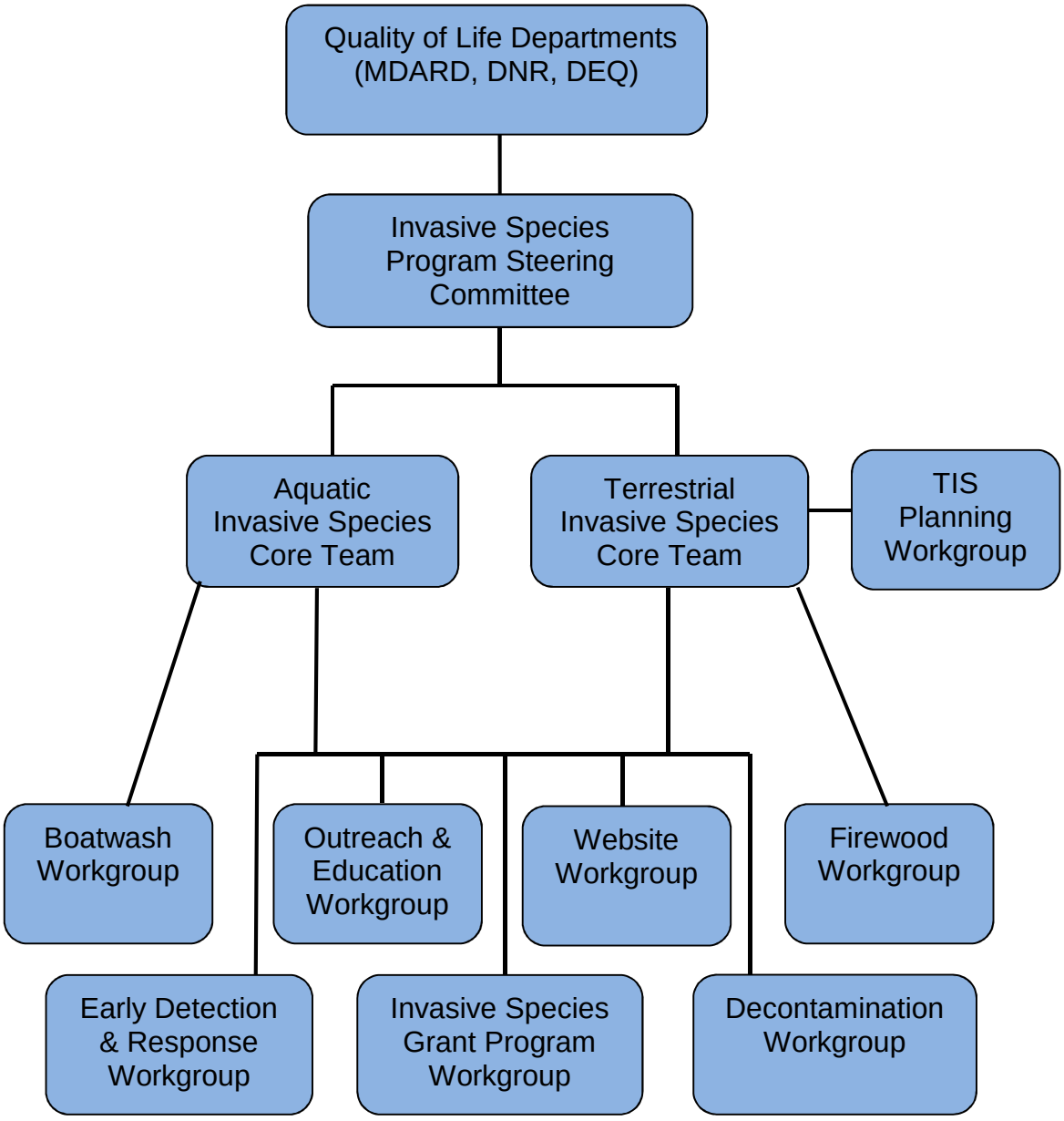
BMP	Best management practices (BMPs) are a set of guidelines for managing or controlling the spread of invasive species based on tested methods.
Bio-control	Bio-control or biological control is the reduction of pest populations by natural enemies and typically involves an active human role.
CISMA	Cooperative Invasive Species Management Areas (CISMAs) are local organizations that facilitate collaboration across jurisdictional boundaries for more effective invasive species management.
Control	Preventing or eliminating the spread of an already established invasive species population.

Detection	Discovering the occurrence of an invasive species at a new or previously unconfirmed location.
Ecosystem	A community of living organisms (plants, animals and microbes) in conjunction with the nonliving components of their environment (air, water and mineral soil), interacting as a system.
Establishment	An invasive species is considered established once its population has spread over a large geographic area or has persisted for an amount of time such that control or eradication of the population is increasingly difficult, if not impossible.
Eradication	Completely removing an invasive species population from a location.
Introduction	The release or propagation of a non-native species to a particular location or environment. There are many modes of introduction.
Management	Actions taken to minimize negative impacts of established invasive species populations or prevent the establishment of new invasive species.
Mitigate	Taking measures to lessen the severity of impacts.
Monitoring	Systematic surveillance of invasive species to collect information regarding status and spread of known invasive species and the collection of data to evaluate progress and effectiveness of proposed activities.
NREPA	In 1994, the Michigan legislature gathered together many natural resource and environmental protection laws under Public Act 451, the Natural Resources and Environmental Protection Act. Part 413 was added to NREPA in 2003 and refers specifically to the regulation of invasive species.
Pathways	The means by which invasive species are transported from one location and to another. There are natural, animal and human-assisted pathways (e.g. hitchhikers, shipping, transportation).
Prioritization	Determining invasive species that require substantial attention, both in time and resources, based on potential negative impacts to Michigan's environment, economy and the health of its citizens.

Rehabilitation and Restoration	The process of renewing or restoring land to a desired state after degradation or disturbance by invasive species. Practices may differ between rehabilitation and restoration. Rehabilitation typically requires removal of toxins, amending soil conditions and preparing land to be restored. Restoration may involve establishing plant communities and creating desired species compositions.
Response	Actions taken in reaction to detection of an invasive species. Response options vary widely but may include confirming the detection and applying mechanical, chemical or physical treatments.
Risk analysis	A mechanism for identifying the potential impacts associated with introduction and spread of an invasive species. This technique also helps to define preventive measures to reduce the probability of these impacts from occurring.
Risk assessment	A system of assessing the level of risk posed by an invasive species based on impacts identified through a risk analysis process. Risk assessments are a useful tool used to help prioritize invasive species for surveillance and response.
Survey	Systematic examination of a pre-determined area to detect and record invasive species on the landscape. Surveys provide data on new detections, existing populations and species distribution.
Terrestrial	A plant or animal living on land as opposed to in water or in the air. Terrestrial animals are those that live on or in the ground; terrestrial plants grow in soil versus in water or air.

Appendix A. Invasive Species Program Governance

The Invasive Species Program governance structure within the Michigan Quality of Life Departments of Agricultural and Rural Development (MDARD), Natural Resources (DNR), and Environmental Quality (DEQ).



Appendix B. List of Priority Terrestrial Invasive Species

Terrestrial Invasive Species Watch List

The invasive species included on the watch list are priority species that have been identified as posing an immediate and significant threat to Michigan's natural resources. These species have either never been confirmed in Michigan, have very limited distribution, or are localized. Early detection and timely reporting of occurrences of these species is crucial for increasing the likelihood of stopping an invasion and limiting negative ecological and economic impacts.

Terrestrial Invasive Species Watch List

Common Name (P indicates a Prohibited or R-Restricted Species)	**Scientific Name**	**Category**
Asian longhorned beetle (P)	*Anoplophora glabripennis*	Insect
Asiatic sand sedge	*Carex kobomugi Ohwi*	Herbaceous Plant
Balsam woolly adelgid	*Adelges piceae*	Insect
Chinese yam	*Dioscorea oppositifolia L.*	Vine
Hemlock woolly adelgid	*Adelges tsugae*	Insect
Himalayan balsam	*Impatiens glandulifera*	Herbaceous Plant
Japanese stiltgrass	*Microstegium vimineum (Trin.) A. Camus*	Herbaceous Plant
Kudzu	*Pueraria montana var. lobata*	Woody Vine
Mile-a-minute weed	*Persicaria perfoliata*	Herbaceous Plant
Mountain pine beetle	*Dendroctonus ponderosae*	Insect
Nutria	*Myocastor coypus*	Mammal
Thousand cankers disease	*Pityophthorus juglandis, Geosmithia morbida*	Tree Disease

Prohibited or Restricted Terrestrial Invasive Species

Terrestrial species as defined in the Natural Resources and Environmental Protection Act 451 of 1994, Section 324.41301. (See Appendix B)

Prohibited and Restricted Terrestrial Invasive Species

Common Name (P indicates a Prohibited and R-Restricted Species)	**Scientific Name**	**Category**
Asian longhorned beetle (P)	*Anoplophora glabripennis*	Insect
Autumn olive (R)	*Elaeagnus umbellata*	Shrub
Brown garden snail (P)	*Helix aspersa*	Mollusk
Carthusian snail (P)	*Monacha cartusiana*	Mollusk
Emerald ash borer (P)	*Agrilus planipennis*	Insect
Eurasian collared dove (P)	*Streptopelia decaocto*	Bird

Feral swine (P)	*Sus scrofa Linnaeus*	Mammal
Giant African snail (P)	*Achatina fulica*	Mollusk
Giant hogweed (P)	*Heracleum mantegazzianum*	Herbaceous Plant
Girdled snail (P)	*Hygromia cinctella*	Mollusk
Heath snail (P)	*Xerolenta obvia*	Mollusk
Japanese knotweed (P)	*Fallopia japonica*	Herbaceous Plant
Nutria (P)	*Myocastor coypus*	Mammal
Wrinkled dune snail (P)	*Candidula intersecta*	Mollusk

Other High Priority Terrestrial Invasive Species

The species in this list are included for at least one of the following reasons: numerous land managers in Michigan report them as a significant problem on their lands; they are included in federal, regional or state listings of invasive species; there is research literature documenting their adverse impacts on native plant and animal communities. Inclusion in this list does NOT imply legal status as a prohibited or restricted species as defined in Michigan's Natural Resources and Environmental Protection Act 451 of 1994, Section 324.41301. Also, this list does not rank individual species by their level of threat—determining the "invasiveness" of each species is a complex process still ongoing for Michigan. However, all of the included species have been noted as invasive somewhere in the Midwest. Several of the plants in this list are readily available in the horticultural trade and this list makes no recommendations as to their sale, planting, or presence on lands where they may pose little threat to natural landscapes. Not all species are equally invasive and in some cases cultivars may not share the invasive traits of their parent species.

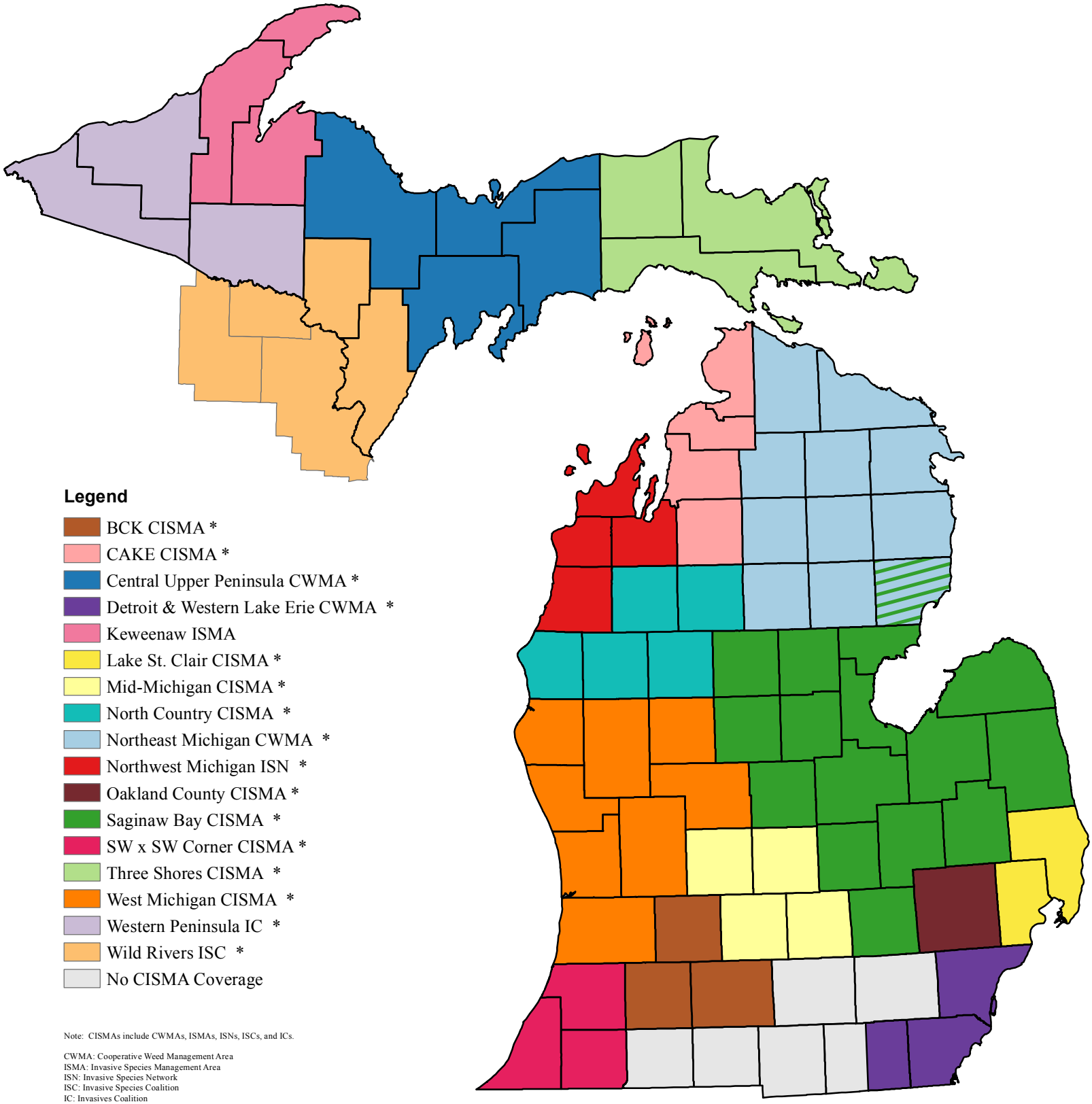
Other High Priority Terrestrial Invasive Species

Common Name	Scientific Name	Category
Amur honeysuckle	*Lonicera maackii*	Shrub
Asian bittersweet	*Celastrus orbiculatus*	Woody Vine
Baby's breath	*Gypsophila paniculata*	Herbaceous Plant
Beech bark disease	*Cryptococous fagisuga, Nectria*	Tree Disease
Bell's honeysuckle	*Lonicera xbella*	Shrub
Black alder	*Alnus glutinosa*	Tree
Black jetbead	*Rhodotypos scandens*	Shrub
Black locust	*Robinia pseudoacacia*	Tree
Black swallow-wort	*Cynanchum louiseae (Vincetoxicum nigrum)*	Herbaceous Plant
Canada thistle	*Cirsium arvense*	Herbaceous Plant
Common buckthorn	*Rhamnus cathartica*	Shrub
Dame's rocket	*Hesperis matronalis*	Herbaceous Plant
European swamp thistle	*Cirsium palustre*	Herbaceous Plant

Garlic mustard	*Alliaria petiolata*	Herbaceous Plant
Giant knotweed	*Polygonum sachalinense*	Herbaceous Plant
Glossy buckthorn	*Frangula alnus (Rhamnus frangula)*	Shrub
Japanese barberry	*Berberis thunbergii*	Shrub
Japanese honeysuckle	*Lonicera japonica*	Woody Vine
Leafy spurge	*Euphorbia esula*	Herbaceous Plant
Lyme-grass	*Leymus arenarius*	Herbaceous Plant
Morrow's honeysuckle	*Lonicera morrowii*	Shrub
Multiflora rose	*Rosa multiflora*	Shrub
Narrow-leaved bitter-cress	*Cardamine impatiens*	Herbaceous Plant
Norway maple	*Acer platanoides*	Tree
Oak wilt	*Ceratocystis fagacearum*	Tree Disease
Pale swallow-wort	*Cynanchum rossicum (Vincetoxicum rossicum)*	Herbaceous Plant
Privet	*Ligustrum vulgare*	Shrub
Reed canarygrass	*Phalaris arundinacea*	Herbaceous Plant
Russian olive	*Elaeagnus angustifolia*	Tree
Spotted knapweed	*Centaurea stoebe (Centaurea maculosa)*	Herbaceous Plant
Tatarian honeysuckle	*Lonicera tatarica*	Shrub
Tree of heaven	*Ailanthus altissima*	Tree
White sweet clover	*Melilotus alba*	Herbaceous Plant
Wild parsnip	*Pastinaca sativa*	Herbaceous Plant
Yellow sweet clover	*Melilotus officinalis*	Herbaceous Plant

Appendix C.

Michigan
Cooperative Invasive Species Management Areas (CISMAs)



Legend

- BCK CISMA *
- CAKE CISMA *
- Central Upper Peninsula CWMA *
- Detroit & Western Lake Erie CWMA *
- Keweenaw ISMA
- Lake St. Clair CISMA *
- Mid-Michigan CISMA *
- North Country CISMA *
- Northeast Michigan CWMA *
- Northwest Michigan ISN *
- Oakland County CISMA *
- Saginaw Bay CISMA *
- SW x SW Corner CISMA *
- Three Shores CISMA *
- West Michigan CISMA *
- Western Peninsula IC *
- Wild Rivers ISC *
- No CISMA Coverage

Note: CISMAs include CWMAs, ISMAs, ISNs, ISCs, and ICs.

CWMA: Cooperative Weed Management Area
ISMA: Invasive Species Management Area
ISN: Invasive Species Network
ISC: Invasive Species Coalition
IC: Invasives Coalition

* Funded by the 2014 & 2015 MISGP

Updated February 2016
Michigan Invasive Species Coaltiion

Appendix D. Implementation Table

Michigan Terrestrial Invasive Species State Management Plan

Activity Area I: Risk Analysis

Objective	Strategic Action	Example Tasks	Measure of Success	Goals*				Lead State Agency	Cooperating Agency or Organization
				P	E	R	C		
I.A. Identify and prioritize ecosystems vulnerable to TIS.	I.A.1. Implement a science-based risk-assessment process to analyze the level of ecosystem susceptibility and vulnerability to TIS.	Identify and evaluate existing risk-assessment processes. Refine and adapt processes for use by state agencies and partners.	Risk-assessment process in place.	X	X	X	X	DARD DEQ DNR	Academia, NGOs, Federal agencies
	I.A.2. Define high-value ecosystems to facilitate prioritization of detection, response and management efforts.	Gather information on high-value ecosystems within plans and among partners.	High-value ecosystems identified.	X	X	X		TIS Core Team	Academia, NGOs, Federal agencies
I.B. Identify and prioritize current and potential high-threat TIS.	I.B.1. Implement a science-based risk-assessment process to analyze the level of risk of potential TIS and likelihood of introduction.	Identify and evaluate existing risk-assessment processes. Refine and adapt processes for use by state agencies and partners.	Risk-assessment process in place.	X	X		X	DARD DEQ DNR	Academia, NGOs, Federal agencies
	I.B.2. Develop prioritization process for prevention, detection and control of TIS.	Create or adapt from existing processes, and distribute for use by partners, agencies, NGOs	Prioritization process developed, documented and implemented.	X	X	X	X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
I.C. Analyze the impacts of landscape level factors.	I.C.1. Identify potential TIS, impacts and pathway changes under various climate change scenarios.	Support or conduct scientific inquiry on effects of different climate change scenarios on TIS. Identify potential risks posed by changing climates.	Results are disseminated.	X	X			DARD DEQ DNR	Industries, NGOs, Academia, local, state, federal and tribal agencies
	I.C.2 Identify contributing factors that inhibit management of TIS e.g. non-point source pollution, urbanization, fragmentation, ownership patterns, etc.	Support or conduct scientific inquiry on effects of contributing factors on TIS. Identify potential risks posed.	Results are disseminated.		X	X		DARD DEQ DNR	Industries, NGOs, Academia, local, state, federal and tribal agencies
I.D. Analyze pathways of TIS introduction and spread.	I.D.1 Further refine and prioritize current list of TIS pathways and associated subpathways.	Support or conduct scientific inquiry on pathways and subpathways. Conduct pathway analysis.	Results of analysis distributed.	X	X			DARD DEQ DNR	Academia, NGOs
	I.D.2 Periodically review known and identify emerging TIS pathways.	Conduct annual review of pathway analysis.	Annual review conducted.	X	X			DARD DEQ DNR	Academia, NGOs

Activity Area II: Management Measures

Objective	Strategic Action	Example Tasks	Measure of Success	Goals*				Lead State Agency	Cooperating Agency or Organization
				P	E	R	C		
II.A. Minimize impacts of TIS through control activities.	II.A.2. Ensure control actions have expected outcomes and measures of success.	Provide staff and partners with training on developing outcomes and measures of success.	# Projects with outcomes and measures of success.	X		X		TIS Core Team	NGOs, Academia, local, state, federal and tribal agencies
	II.A.3. Evaluate treatments and actions.	Use common indicators to measure level of control success.	# Actions met or exceeded target level of control.			X	X	TIS Core Team	NGOs, Academia, local, state, federal and tribal agencies
II.B. Decrease likelihood of new TIS establishing and spreading in Michigan.	II.B.1. Build partnerships and recruit partners in response efforts.	Outreach to potential partners.	List of partners.			X	X	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies

* **P** = Prevention, **E** = Early Detection/Response, **R** = Restoration/Control, **C** = Collaboration

Appendix D. Implementation Table

Activity Area II: Management Measures (cont'd)									
Objective	**Strategic Action**	**Example Tasks**	**Measure of Success**	**Goals***				**Lead State Agency**	**Cooperating Agency or Organization**
				P	**E**	**R**	**C**		
II.B. (cont'd) Decrease likelihood of new TIS establishing and spreading in Michigan.	II.B.2. Respond to reports of new TIS through implementation of actions outlined in the TIS Response Plan.	Increase capacity and apply resources according to level of infestation.	# Responses.			**X**		DARD DNR	CISMAs, NGOs, Academia, local, state, federal and tribal agencies
	II.B.3. Control or eliminate pathways of introduction or spread.	Identify target pathway and interrupt or control pathway.	# Pathways interrupted or controlled.	**X**		**X**		TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
II.C. Incorporate TIS prevention, detection and control into land management plans and activities.	II.C.1. Assess goals of management activities and identify TIS that may impact management.	TIS surveys and databases are consulted during development of management plans.	Information on presence and abundance of TIS included in management plans. Management goals are achievable	**X**	**X**	**X**		Land Managers and Planners	TIS Core Team
	II.C.2. Ensure permits address known TIS threats and best management practices for prevention and control.	Draft standard permit conditions for use by review staff and partners addressing TIS.	Standard permit conditions available for staff and other governments.	**X**	**X**	**X**	**X**	TIS Core Team	Local, state and tribal agencies
	II.C.3. Identify and mitigate land management activities that facilitate introduction and spread of TIS through known pathways.	Identify target species, pathways and BMPs.	# Management plans include BMPs to prevent the spread of invasive species.	**X**	**X**	**X**		Land Managers and Planners	TIS Core Team
	II.C.4. Increase number of management activities that contribute to a reduction in TIS.	Document target species for control. Identify management actions that help control TIS.	# Control activities increasing.			**X**	**X**	Land Managers and Planners	TIS Core Team
II.D. Prevent future TIS invasions and restore ecosystem integrity through enhanced restoration and rehabilitation strategies.	II.D.1. Support programs conducting restoration and rehabilitation work.	Identify resources for restoration work and highlight successes and accomplishments.	Resources identified. # Success stories.			**X**	**X**	TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal agencies
	II.D.2. Develop and implement prioritization techniques for restoration and rehabilitation projects.	Work with agencies and partners to identify restoration priorities. Develop and distribute prioritization guidelines.	Guidelines created and made available.			**X**		TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal agencies
	II.D.3. Assess effectiveness of restoration and rehabilitation efforts.	Engage in pre and post restoration monitoring. Communicate results of restoration activities.	Monitoring results documented and shared.	**X**	**X**	**X**		TIS Core Team	Land managers
	II.D.4. Develop new and improve existing restoration and rehabilitation techniques.	Evaluate, coordinate and improve existing techniques. Provide staff and partners with training on new techniques.	# Trainings offered.			**X**	**X**	TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal agencies

*** P** = Prevention, **E** = Early Detection/Response, **R** = Restoration/Control, **C** = Collaboration

Appendix D. Implementation Table

Activity Area III: Monitoring and Research									
Objective	**Strategic Action**	**Example Tasks**	**Measure of Success**	**Goals***				**Lead State Agency**	**Cooperating Agency or Organization**
				P	**E**	**R**	**C**		
III.A. Improve surveillance, reporting and data management with a focus on pathways, risk analysis and early detection.	III.A.1. Expand and improve existing information gathering and data sharing networks.	Develop additional functionality and improve accessibility of centralized data sharing networks. Promote centralized network through multimedia outreach efforts.	# users reporting added; # reportable species added; # reports received.	**X**	**X**		**X**	TIS Core Team	MISIN, Academia, NGOs
	III.A.2. Develop, distribute and implement standardized monitoring and reporting protocols for use by multiple agencies and partners.	Evaluate, coordinate and streamline existing protocols and procedures. Provide staff and partners with training on protocols. Conduct routine monitoring and report data to centralized database.	Protocols developed; # trainings or training resources provided.		**X**		**X**	DARD DEQ DNR	MISIN, Academia, NGOs, local, state, federal and tribal agencies
	III.A.3. Monitor vulnerable ecosystems in rural and urban terrestrial environments.	Conduct or support routine monitoring using standardized protocol.	# sites monitored		**X**			TIS Core Team	Academia, NGOs, local, state, federal and tribal agencies
	III.A.4. Enhance and implement detection efforts at strategic points of entry and high risk pathways.	Identify strategic points of entry. Train and deploy staff to conduct targeted surveillance.	Detection efforts enhanced at strategic locations.		**X**			DARD-PPPM & AID DNR-WLD &FRD	Academia, NGOs
	III.A.5. Build knowledge base of the distribution and abundance of existing key terrestrial invasive species.	Collect, analyze, summarize and distribute data on TIS detections. Provide maps, briefings and other informational materials on species distribution to public, partners and staff.	Data analyzed and results distributed via websites, published results, etc.		**X**		**X**	DARD-PPPM & AID DNR-WLD &FRD	Academia, NGOs
III.B. Expand research on TIS.	III.B.1. Quantify economic, ecologic, social and landscape level impacts of TIS.	Support and track research.	# New studies on TIS impacts.	**X**	**X**	**X**		TIS Core Team	Academia, NGOs
	III.B.2. Support research priorities with a focus on prevention, detection and restoration.	Support and track research.	# New research projects on TIS prevention, detection and restoration.	**X**	**X**	**X**	**X**	TIS Core Team	Academia, NGOs
	III.B.3. Identify and develop promising control technology, including bio-control, for key invasive species.	Support and track research.	# New technologies developed. \# Bio-control introduced.		**X**	**X**		TIS Core Team	Academia, NGOs
III.C. Track implementation and assess effectiveness of TIS plan.	III.C.1. Develop a system for tracking activities and accomplishments by agencies and partners.	Identify tracking requirements and mechanisms. Create database for documenting activity. Promote easy access of database for reporting.	Database developed.	**X**	**X**		**X**	TIS Core Team	CISMAs, Academia, NGOs, local, state, federal and tribal agencies
	III.C.2. Evaluate actions implemented under this plan.	Determine if outcomes meet measures of success.	Progress on actions documented.	**X**	**X**	**X**		TIS Core Team	Academia, NGOs
	III.C.3. Monitor accomplishments and provide annual update to decision-makers and stakeholders.	Compile information on accomplishments. Determine method of reporting and end users. Provide written or oral updates.	Report of accomplishments provided.	**X**	**X**	**X**	**X**	TIS Core Team	Academia, NGOs

*** P** = Prevention, **E** = Early Detection/Response, **R** = Restoration/Control, **C** = Collaboration

Appendix D. Implementation Table

Activity Area IV: Outreach and Education									
Objective	**Strategic Action**	**Example Tasks**	**Measure of Success**	**Goals***				**Lead State Agency**	**Cooperating Agency or Organization**
				P	**E**	**R**	**C**		
IV.A. Increase public awareness of TIS impacts and threats utilizing public and private partnerships.	IV.A.1. Develop or use existing outreach campaigns tailored to specific audiences, integrating the use of social media, videos, printed and web-based materials.	Identify audiences, identify and evaluate existing efforts and determine the need for new efforts. Make recommendations and develop materials.	Audiences identified, recommendations made, materials developed and distributed.			**X**		TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.A.2. Provide education and outreach through symposia and workshops for landowners, local government officials, resource management professionals and retail trade.	Present information regarding TIS through oral presentations. Distribute printed materials at conferences, meetings, etc. Hold workshops for landowners, professionals and partners	# Presentations given; # workshops held; # conferences attended			**X**	**X**	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.A.3. Incorporate TIS into educational programming for youth and adults.	Evaluate existing educational programming for k-12 and adults. Identify needs and potential partners for enhanced programming. Develop resources for teachers and extension offices.	TIS in the curriculum.	**X**		**X**	**X**	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.A.4. Assess changes in attitudes and behavior through surveys of target audiences.	Develop and distribute stakeholder survey	Survey developed. Results analyzed.	**X**	**X**	**X**		TIS Core Team	Academia, NGOs
IV.B. Prevent the introduction and limit the spread of TIS through public outreach, staff training and information sharing.	IV.B.1. Enhance existing and develop additional training resources on identification of TIS.	Develop TIS identification course.	Trained staff and volunteers in TIS.	**X**	**X**	**X**	**X**	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.B.2. Improve and simplify access to resources for training and reporting.	Identify resources available.	List of resources available with access information	**X**	**X**	**X**		TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.B.3. Engage partners and the public in identification of high threat TIS and reporting to a centralized database.	Outreach on MISIN.	# New users MISIN. # Reports increasing.	**X**	**X**	**X**	**X**	TIS Core Team	CISMAs, MISIN, NGOs, Academia
	IV.B.4. Develop pathway-oriented outreach materials to distribute to target audiences at strategic locations.	Identify target species and develop pathway-oriented materials	List of distribution points.	**X**	**X**	**X**		TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.B.5. Provide education on decontamination and Best Management Practices (BMPs) to limit the spread of TIS.	Evaluate existing BMPs and develop additional. Provide electronic access to BMPs and resources on decontamination. Develop videos and instructional materials for decontamination.	Electronic materials developed and made available.	**X**	**X**	**X**		TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
IV.C. Improve the effectiveness of TIS control through education and training on control measures.	IV.C.1. Provide training opportunities on BMPs, control methodology and treatment monitoring.	Schedule and host trainings for partners, staff and the public. Create web-based training resources.	# trainings hosted; # online modules developed.	**X**	**X**			TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.C.2. Develop outreach materials informing public about TIS, management, control, and outcomes.	Develop materials. Update websites with new and relevant information.	Materials available for outreach	**X**	**X**			TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies
	IV.C.3. Promote protective measures and BMPs through communication and coordination with partners.	Use partner group meetings, conferences and events to promote BMPs and distribute information.	# of events	**X**	**X**		**X**	TIS Core Team	CISMAs, Industries, NGOs, Academia, local, state, federal and tribal agencies

*** P** = Prevention, **E** = Early Detection/Response, **R** = Restoration/Control, **C** = Collaboration

Appendix D. Implementation Table

Activity Area V: Regulation and Policy									
Objective	**Strategic Action**	**Example Tasks**	**Measure of Success**	**Goals***				**Lead State Agency**	**Cooperating Agency or Organization**
				P	**E**	**R**	**C**		
V.A. Improve regulatory and policy frameworks for invasive species management.	V.A.1. Use results of risk assessments to conduct annual review and update the Prohibited and Restricted Species List (NREPA Part 413).	Review existing and emerging TIS threats. Provide recommendations for adding or removing species from Part 413 list.	Annual recommendations provided	**X**			**X**	DARD DEQ DNR	Academia, Federal agencies
	V.A.2. Identify and address gaps in state policies, procedures, permits, land use orders, quarantines and legislation.	Evaluate existing legislation and regulations that affect TIS management goals and SMP implementation. Provide briefing on current status.	Review conducted. Briefing provided.	**X**	**X**		**X**	TIS Core Team	Local, state and federal agencies
	V.A.3. Enhance enforcement of existing TIS legislation and policies.	Evaluate enforcement and compliance mechanisms. Make recommendations on the need for enhanced measures. Initiate enforcement action on violators.	Recommendations submitted. Violations documented and enforcement action taken	**X**	**X**		**X**	DARD-PPPM DNR-LED	State police, Attorney General's office, local prosecutors
V.B. Secure resources for high-priority invasive species projects.	V.B.1. Identify resource needs and funding gaps for implementation of invasive species projects.	Conduct an inventory of existing resources and projects. Determine where program gaps and needs exist.	Inventory list: gap list	**X**	**X**	**X**	**X**	TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal agencies
	V.B.2. Leverage existing resources and develop incentives to maximize management capacity.	Evaluate existing grant programs and improve processes. Identify potential projects for collaboration or match. Explore incentives to manage invasive species.	Grant programs established or improved. TIS SMP actions funded. # New incentives in place.	**X**	**X**	**X**	**X**	DARD DEQ DNR	Industries, NGOs, Academia, Federal agencies
	V.B.3. Create stable funding sources for TIS.	Identify potential funding sources to address program gaps. Develop and submit funding proposals	Proposals submitted	**X**	**X**	**X**	**X**	TIS Core Team	Industries, NGOs, Academia, Tribes; Federal, state and provincial agencies

Activity Area VI: Leadership and Coordination									
Objective	**Strategic Action**	**Example Tasks**	**Measure of Success**	**Goals***				**Lead State Agency**	**Cooperating Agency or Organization**
				P	**E**	**R**	**C**		
VI.A. Improve capacity to detect early and respond to high-threat and emerging TIS.	VI.A.1. Develop an interagency TIS Response Plan.	Adapt existing AIS Early Detection and Response Plan and Policy to include TIS.	Invasive Species Response Plan and Policy adapted.		**X**		**X**	DARD-PPPM & AID, DNR-WLD & FRD	USDA, USFS, CISMAs
	VI.A.2. Develop and support a first detector network of trained personnel at strategic locations.	Identify key detection locations; Train field personnel on identification; provide detectors with ID, reporting and outreach resources	First Detector Network in place	**X**	**X**		**X**	DARD-PPPM & AID DNR- WLD & FRD	NGOs, Academia, local, state, federal, and tribal agencies
	VI.A.3. Develop and implement species-specific response plans.	Identify barriers for detection and response. Identify key actions and personnel for response implementation.	Response plans developed for all watch list species. 90% of barriers addressed or removed.	**X**	**X**	**X**	**X**	DARD DNR	NGOs, Academia, local, state, federal and tribal agencies
	VI.A.4. Test and evaluate response plans through mock detections or exercises.	Conduct species-specific response exercises to test response plans for high threat species. Involve interactions of all agencies and define roles, authorities and resources. Develop After Action Reports to evaluate mock responses.	# Mock exercises conducted # After Action Report items addressed	**X**	**X**		**X**	DARD-PPPM & AID DNR-WLD & FRD	USDA, USFS, CISMAs
VI.B. Increase technical expertise available for TIS information and identification.	VI.B.1. Establish a network of experts to provide updated facts, figures and details to inform TIS planning.	Determine extra-agency experts on TIS and solicit involvement in Core Team activities.	List of experts created.	**X**	**X**	**X**	**X**	TIS Core Team	NGOs, Academia, CISMAs, local, state, federal and tribal agencies

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Activity Area VI: Leadership and Coordination (cont'd)									
Objective	**Strategic Action**	**Example Tasks**	**Measure of Success**	**Goals***				**Lead State Agency**	**Cooperating Agency or Organization**
				P	**E**	**R**	**C**		
VI.B. (cont'd) Increase technical expertise available for TIS information and identification.	VI.B.2. Create and maintain list of taxa specific TIS verification experts.	Identify experts on specific TIS taxa and resources for verification of specimens. Document and address gaps.	List of experts created. Gaps in expertise identified and filled.	**X**	**X**	**X**	**X**	TIS Core Team	NGOs, Academia, CISMAs, local, state, federal and tribal agencies
VI.C. Prevent and manage TIS through coordination and collaboration with partners at multiple levels.	VI.C.1. Find common approaches to harmonize cross-jurisdictional action with federal and state agencies and local municipalities.	Strengthen and support regional partnerships and initiatives. Identify and address barriers to action and collaboration. Increase coordinated efforts with local government.	50% of barriers removed. # Coordinated efforts and actions.	**X**	**X**	**X**	**X**	TIS Core Team	Federal, state, provincial, tribal and local agencies, CISMAs
	VI.C.2. Develop and support vital partnerships to increase understanding of impacts, available resources and needed capacity.	Compile list of existing TIS partnerships. Evaluate effectiveness and identify gaps.	Vital partnerships are in place and active through MOUs, plans, proposals or other collaborative opportunities.	**X**	**X**	**X**	**X**	TIS Core Team	CISMAs, MISC, IFIC, NGOs, Academia, local, state, federal and tribal agencies
	VI.C.3. Work collaboratively with industry to address pathways of introduction through prevention, detection and control.	Work with potential industry partners. Identify potential actions to mitigate TIS introduction and spread via industry related pathways.	75% of mutually agreed actions to prevent TIS through firewood, wood products and organisms in trade pathways are implemented. 50% of land managing industries are equipped to identify invasive species and take action on lands they manage.	**X**	**X**	**X**	**X**	DARD DNR	Industries, Academia, NGOs
	VI.C.4. Foster partnerships that increase the likelihood of management and research success to eliminate duplicative efforts and expenditures.	Work with agencies and organizations conducting TIS management and/or research to evaluate efforts and identify potential cross-over.	# Coordinated efforts and actions.	**X**	**X**	**X**	**X**	TIS Core Team	Industries, NGOs, Academia, local, state, federal and tribal agencies

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Law or Regulation	Agency/Agencies	Summary
Animal Industry Act, 1998 PA 466 as amended	DARD	The Animal Industry Act includes measures "to protect the human food chain and the livestock and aquaculture industries of the state through prevention, control, and eradication of infectious, contagious, or toxicological diseases of livestock and other animals; to prevent the importation of certain nonindigenous animals under certain circumstances."
Cooperative Forestry Assistance Act of 1978, as amended (16 U.S.C. 41)	USDA - Forest Service	The Cooperative Forestry Assistance Act (16 U.S.C. 41) includes provisions for the prevention and control of insects and diseases affecting trees and forests and for broadening existing forest management, fire protection, insect and disease protection programs on non-Federal forest lands.
Certification of Seed (1959 P.A. 221)	DARD	Certification of Seed defines certified and certain other classes of seed and authorizes the Director to develop rules, regulations and standards regarding certification and seed classes.
Field Seed Certification - DARD Regulation No. 623	DARD	The Field Seed Certification Regulation defines and establishes standards and processes for seed certification for field crop and turf grass seeds.
Seed Potato Certification - DARD Regulation No. 628	DARD	The Seed Potato Certification Regulation defines and establishes standards and processes for potato seed certification.
Seed Law Implementation - Regulation 715	DARD	The Seed Law Implementation Regulation provides the state list of prohibited and restricted noxious weeds
Federal Seed Act (7 C.F.R. part 201)	USDA	The Federal Seed Act establishes standards for records, maintenance, labeling and oversight for agricultural and vegetable seeds.
Food Security Act of 1985 (16 U.S.C. 3801-3862)	USDA - NRCS	The Food Security Act of 1985, also referenced as the 1985 Farm Bill, allowed lower commodity prices and income supports and also established the Conservation Reserve Program (CRP), sodbuster and swampbuster regulations.
Forest Service Organic Administration Act of 1897 (16 U.S.C. 2)	USFS	The Organic Administration Act authorizes the establishment and administration of national forests.
The Insect Pest and Plant Disease Act - 1931 P.A. 189.	DARD	The Insect Pest and Plant Disease Act of 1931 regulates the sale and distribution of plant materials to prevent the introduction and spread of plant pests and diseases.

Law or Regulation	Agency/Agencies	Summary
Insect Pests and Plant Diseases 1945 P.A. 72)	DARD	The Insect Pest and Plant Disease Act of 1945 authorizes measures to "prevent the importation from other states, and the spread within this state, of all serious insect pests and contagious plant diseases and to provide for their repression and control, imposing certain powers and duties on the commissioner of agriculture."
Lacey Act (18 U.S.C. 42)	USFWS	Under the Lacey Act (18 U.S.C. 42), the Secretary of the Interior is authorized to regulate the importation and transport of species, including offspring and eggs, determined to be injurious to the health and welfare of humans, the interests of agriculture, horticulture or forestry, and the welfare and survival of wildlife resources of the U.S. These injurious species may not be imported into or transported between states, districts or territories of the U.S. without a permit issued by the U. S. Fish and Wildlife Service. The 2008 Farm Bill (the Food, Conservation, and Energy Act of 2008), amended the Lacey Act by expanding its protection to a broader range of plants and plant products. The Lacey Act now also makes it unlawful to import certain plants and plant products without an import declaration.
Species Injurious to Wildlife as defined by the Lacey Act		A comprehensive list of species defined as injurious to wildlife through the Lacey Act.
Large Carnivore Act (2000 P.A. 274)	DARD	The Large Carnivore Act regulates the ownership, posession and care of certain large carnivores.
Michigan Seed Law (1965 P.A. 329)	DARD	The Michigan Seed Law includes regulation of the labeling, coloration, advertising, sale, offering, exposing, or transporting for sale of agricultural, vegetable, lawn, flower, and forest tree seeds and authorizes the director of agriculture to adopt rules for the enforcement of this act.
National Environmental Policy Act (NEPA) 42 U.S.C. 4321 et seq. (1969)	USFS	The National Environmental Policy Act provides for the proper consideration to the environment prior to undertaking any major Federal action that significantly affects the environment and establishes requirements for environmental assessments and/or environmental impact statements.

Law or Regulation		Agency/Agencies	Summary
Natural Resources and Environmental Protection Act (NREPA) 1994 PA 451 as amended		DNR, NRC, DEQ, DARD	NREPA's purpose is to "protect the environment and natural resources of the state; to codify, revise, consolidate, and classify laws relating to the environment and natural resources of the state; to regulate the discharge of certain substances into the environment; to regulate the use of certain lands, waters, and other natural resources of the state; to protect the people's right to hunt and fish; to prescribe the powers and duties of certain state and local agencies and officials; to provide for certain charges, fees, assessments, and donations; to provide certain appropriations; to prescribe penalties and provide remedies; and to repeal acts and parts of acts."
	Part 413, Transgenic and Non-native Organisms, MCL	DARD, DNR	Part 413 of NREPA defines prohibited and restricted species in Michigan and limits the possession, import or sale of such species.
	The Natural Resources Commission Prohibited and Restricted Aquatic Invasive Species Order Amendment 1 of 2014	DARD, DNR, DEQ	The Natural Resources Commission Prohibited and Restricted Aquatic Invasive Species Order Amendment 1 of 2014 adds to the list of prohibited and restricted species in Michigan outlined in Part 413 of NREPA.
	List of Prohibited and Restricted Species in Michigan	DARD, DNR, DEQ	The Prohibited and Restricted Species List indicates currently prohibited and restricted species in Michigan as expressed in Part 413 of NREPA and invasive species orders.
Noxious Weeds Act - 1941 P.A.359		DARD	The Noxious Weeds Act provides for the control and eradication of noxious weeds by outlining powers of municipal and local governments.
Plant Protection Act (7 U.S.C. 7701)		USFWS	The Plant Protection Act of 2000, (7 U.S.C. 7701 et seq.) which includes the Noxious Weed Control and Eradication Act of 2004, regulates the movement of plants, plant products, biological control organisms, and noxious weeds and authorizes the Secretary of Agriculture to "publish, by regulation, a list of noxious weeds that are prohibited or restricted from entering the United States or that are subject to restrictions on interstate movement within the United States."

Law or Regulation	Agency/Agencies	Summary
Federal Noxious Weed List		The Federal Noxious Weed List is the list of noxious weeds prohibited or restricted by the Plant Protection Act of 2000 as amended.
Presidential Executive Order 13112	DEQ, USFWS, USDA - APHIS, USDA - NRCS, USFS	Presidential Executive Order 13112 (1999) requires that the National Invasive Species Council be created to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.
Privately Owned Cervidae Producers Marketing Act - 2000 P.A. 190.	DARD	The Privately Owned Cervidae Producers Marketing Act defines, develops, and regulates privately owned cervidae as an agricultural enterprise in Michigan and provides relevant power and duties to certain state agencies and departments.
White Pine Blister Rust Act - 1929 P.A. 313.	DARD	The White Pine Blister Rust Act provides for control and eradication of white pine blister rust and declares certain plants and bushes a public nuisance.
Soil and Water Resources Conservation Act of 1977 (16 U.S.C. 40)	USDA - NRCS	The Soil and Water Resources Conservation Act of 1977, as amended provides the United States Department of Agriculture broad strategic assessment and planning authority for the conservation, protection, and enhancement of soil, water, and related natural resources.
Soil Conservation and Domestic Allotment Act of 1935 (16 U.S.C. 590 et seq. as amended)	USDA - NRCS	The Soil Conservation and Domestic Allotment Act authorizes Secretary of Agriculture to conduct soil erosion surveys and prevention measures and to provide funds for soil erosion reduction.
Wildlife Conservation Orders	DNR - WLD	Michigan's Wildlife Conservation Orders regulate hunting, trapping and game species and include regulation, restrictions and permitting for importation of animals, nuisance animal control regulations and disease control permits.